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Editorial

REMOUNTS

THE present war differs strangely from any previous war in which our country has been engaged. Up to the present it might be called a humane war if it were possible to apply such a description to any conflict of arms. Casualty lists have not been long, and animal transport of all kinds has been replaced by inanimate machines. In the case of the British Army this replacement has been almost 100 per cent. We must presume that this last remarkable change has been effected after due consideration and that those in authority have confidence that the machine can perform efficiently those duties which previously fell to the lot of the horse and mule. This may or may not

be the case, but it is hoped sincerely that the confidence of our leaders will be completely justified. If such is the case this change will mark an epoch, for it will signify the greatest humanitarian movement that the world has ever known. Animals have no war aims; they are simply innocent participants at the will of their masters.

We would doubt if there is a single person in this country who would not spare the animals the horrors of war if that were at all possible.

As yet, however, this Utopia is largely one of conjecture and the real trial has not occurred under all types of war conditions. There are many, who are qualified to speak with authority, who say that the role of the horse and mule in war is not finished. Some go further and say that a war cannot be waged successfully without them. It is to be noted that certain foreign armies have not made the complete sweep which has been done by our men. The lessons of the Abyssinian and Spanish wars are of too recent date to be ignored.

War is full of surprises and it may be that the British army will again find the need of animals; indeed, this need may become one of great urgency.

It behoves us, therefore, to be ready, and especially does this advice apply to the veterinary profession, for on its shoulders will fall great responsibility. We welcome, therefore, the article published in this issue on Remount Duty and Remounts. It is an exposition of an experienced officer's views. It gives a fund of information regarding the duties of veterinary officers employed on Remount duties. Major Wall discusses in detail the merits or otherwise of the various breeds and types and gives information as to the sources of supply which will prove of the greatest service to his profession. The article should be of very great service to the younger members of the profession who have entered in recent years and who, owing to the great decline in equine practice in civil life, have not been able to acquire that knowledge and experience which was so manifest in those who were fortunate to practise in what has been called the golden age of the horse.

General Articles

REMOUNT DUTY AND REMOUNTS

By MAJOR R. F. WALL, T.D., M.R.C.V.S.
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THE lot of the average animal used for transport in time of peace is, alas, not an enviable one, but there is no doubt of the happier conditions attending those who are fortunate enough to serve in the army. Participating in the pageantry of the nation, they serve to inspire us with the dignity and splendour of the days of chivalry. We are a peaceful and animal-loving people, and gladly welcome the mechanised transport which saves our animals from the sufferings inevitable during war, but to-day, as in the past, the horse, the mule, the camel, the ox and the humble donkey will still play their highly important parts where mechanical transport fails. Like the men, they can still carry on when the rations are scarce, they can convey food and ammunition to places inaccessible to motor transport and their last service to their country is to afford protection and succour to beleaguered units. For reconnaissance where aircraft and tanks would be unreliable, even if they could approach the parts to be surveyed, they will prove invaluable, particularly at night and when heavy mists or fog are present. Their instinct to detect the presence of danger, as well as to find their way home, is a very real comfort to a man who has lost his bearings.

Mechanisation has not only excluded the horse and mule to a dangerous extent; but it has eliminated, in fact almost exterminated, the personnel familiar with the habits and management of these animals, as recent events have proved. Unfortunately, it does not extend only to grooms, carmen and stable hands, but to the veterinarians responsible for their health and condition and their relation to public health. The farrier, too, is no longer available at a moment's notice, nor is it easy to induce young men to take up the art of farriery when it holds out such a restricted future. Time is required to train the specialist and in the interim not only are the animals exposed to the menace of inexperience, but the army and the nation suffer, and the taxpayer foots the bill. Lack of foresight and preparation leads to high mortality and periods of incapacity. There is a scarcity of men of sound practical experience who may be trusted to purchase animals suitable for military service, and of veterinarians who have acquired by practice sufficient knowledge of equine practice and examination for soundness and serviceability, to discharge satis-

factorily the duties in connection with the purchase of remounts. The result of such inexperience in this respect has often been painfully evident.

For the benefit of members of our profession who may be called to Remount Duty, a brief outline of this branch of the War Department may be of interest and some assistance. The Remount Service is under the control of the Quartermaster-General. The Remount Directorate is a branch of his department and, in addition to this branch at the War Office, there are: (a) the Inspectorial Staff; (b) the Administrative Service, i.e., Deputy Assistant Directors of Remounts attached to Headquarters and the District Remount Officers; (c) Remount Depôts and Farms. Briefly, the duties of the Remount Service include the purchase and issue of suitable animals and all that is required for the maintenance, supply and general welfare of the animals, as well as a knowledge of the sources of supply in the world for peace and for war. At the moment we are concerned with the latter, and peace-time regulations may not be applicable.

On mobilisation all units are brought up to war establishment by: (a) transfers from other units; (b) impressment; (c) purchase in the open market. The majority of animals required on mobilisation are obtained by impressment. They may be of any age from five years upward, provided they are fit for one month's service in the field. With the greatest respect, I take exception to that regulation for the simple reason that it is very likely to induce the purchaser or the veterinary officer to give the benefit of the doubt to a borderline animal that otherwise would not be accepted, especially if the seller is endowed with powers of persuasion. So long as relatively young, sound, active horses are available, the others should be rejected. Many years' experience of Remount duty has strengthened that opinion, and recent observations have emphasised it very considerably.

The purchaser or purchasing officer is responsible for everything concerning the animals except the age, soundness and freedom from contagious disease. Animals are usually purchased at a purchasing post or a collecting centre, from which they are taken by collecting parties, but if the transaction takes place at the stables of the owner he is responsible for the delivery of the animals to the collecting centre if it is within ten miles of his stable. It is the duty of the purchaser to see that the animals are properly branded with a 2½-inch broad arrow, 4 inches below and 4 inches to the right of the point of the hip, and that the brand allotted to him is placed immediately below the broad arrow. It is his duty to see that only animals that have been purchased and properly branded are despatched. In some instances horses are sent direct to the unit, and in such cases I believe the purchaser is also responsible for delivery. Impressed horses are also scissor-marked under the saddle on the near side: riding horses, R; light draught, L; heavy draught, H; pack horses, P; special, D & P (ponies and mules), LA. Information that will help in the "posting" of animals will be written on a label attached to the head collar,

e.g., "quiet hack." The purchaser's name will also be inscribed. The purchaser is provided with a list of average prices to be paid, but it is his privilege to fix the price within the limits set forth. If an owner raises an objection that is not satisfied at the time, he may appeal to the county or sheriff's court for arbitration, within three weeks.

Now for a word about purchasers. That many of them are men of sound common sense, tact and experience as well as being good judges of horses suitable for military purposes, I am well aware from experience, but there are some appointed who lead one to believe that they are devoid of the essential qualifications for the appointment, and one wonders how their services were ever accepted. The purchaser is responsible not only for large sums of the taxpayer's money, but for his obligation to the troops to which the animals he purchases are sent: a very real and heavy responsibility, if one pauses but for a moment to consider it. It is, therefore, incomprehensible that a War Office department should appoint men for such responsible duties without at least some practical demonstration of their ability to fulfil the requirements. With the greatest respect, I submit that purchasers and purchasing officers should be approved by a board of examiners and present satisfactory credentials before their appointment is confirmed. If the appointment is made in time of peace they should attend a proper course of instruction..

As in the case of purchasers, veterinary surgeons detailed for purchasing duty should satisfy the Director-General, R.A.V.C., or an officer appointed by him, that he has had sufficient practical experience of equine practice to qualify him for the appointment. It is quite possible that many of our members may take exception to this on the ground that the diploma of the R.C.V.S. is sufficient indication of the holder being qualified to discharge the duties of the appointment. With respect, I beg to differ, for the reason previously given, viz., that most modern students, and even qualified persons, have not had the opportunity for much experience of equine practice, especially with regard to examination for soundness and to estimate the degree of serviceability.

The duties of the purchasing veterinary surgeon are limited to examining for the age, soundness and freedom from evidence of contagious and infectious diseases. Usually the purchaser and his veterinary surgeon work in happy co-operation, as indeed they should, but there are times when friction arises, and it is usually over the question of whether a horse shall be accepted after having been rejected by the veterinary surgeon. So many of us overlook the fact that we are acting only in an advisory capacity, and that the difficulty can be overcome by making a note on the form B.88 that "the animal is suffering from —— and, therefore, is not fit for military service, but has been purchased contrary to the advice of the veterinary surgeon." I have never known a purchaser override such action by the veterinary surgeon. It is part of the duty of the veterinary surgeon to sign the inspection book.

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A depôt veterinary surgeon is responsible for the health and sanitation of the depôt and the care of the sick animals. Collecting, embarkation and off-loading depôts are generally provided with veterinary hospitals or some accommodation for the sick, with a veterinary surgeon in charge. The Remount Depôt V.O. is responsible for the inspection of animals prior to embarkation and on arrival at the docks they will be inspected by the conducting officer and the ship's veterinary surgeon, who will be responsible for their being in good health, especially freedom from signs of contagious disease, and gives a certificate to that effect. The ship's veterinary surgeon should tour the ship with the conducting officer and make a thorough inspection before the animals come aboard, and submit any recommendations he considers to be necessary. If there is any question as to his suggestions being carried out it is advisable to put them in writing and forward a copy to headquarters. He should advise the conducting officer with regard to hygiene, feeding, etc., and remember to make a written report of the voyage at the time of disembarkation.

Veterinary surgeons whose services are retained for duty on board ship receive the pay and allowances of their rank, or £1 a day while in charge of animals and 10s. a day when not in charge of animals. The scale of bonus allowed is:

2s. 0d.	a head	if losses	do not	exceed	1 per cent.
1s. 6d.	,,	,,	,,	2	,,
1s. 0d.	,,	,,	,,	3	,,
6d.	,,	,,	,,	5	,,
3d.	,,	,,	,,	10	,,

Nil if they exceed 10 per cent.

There is also a free first-class passage to and from the country to which they are sent.

When purchasing is conducted through Remount Commissions abroad the purchasers and the veterinary surgeons are furnished with specifications, including a fixed price for each class supplied by the contractors. Payments are made through headquarters in accordance with the records furnished by the purchaser.

The following brief description of the classes of animals used for military purposes may be of some interest to those not familiar with them and are not provided with a copy of "Remount Regulations":

Officers' Chargers—Cavalry. Hunter type, good quality and manners. Height 15 : 2 to 16 hands.

Officers' Chargers—Other Units. Hunter, 'hack, polo type, not so much quality, but good manners. Height 14 : 3 to 15 : 3 hands.

Household Cavalry troop horse. Quality, good looks, black, up to weight and 16 hands high.

Cavalry troop horse, Cavalry of the Line and R.H.A. and R.A. rider. Hunter type, quality and substance. Height 15 to 15 : 2½ hands.

Riding horse for other arms. Similar to a rider but not over 15 : 1 hands.
Cavalry pack horse. Cavalry troop horse type. Good back.
Heavy draught horse. Active cart horse. Height not over 16 : 1 hands. Weight app. 1,600 lb.
Light draught horse. Active light vanner type. Height 15 to 15 : 3 hands. Weight app. 1,300 lb.
Draught or pack pony for light artillery. 14 to 14 : 3 hands. All pack animals must have strong, straight backs.
Draught or pack mule for light artillery. 14 to 14 : 3 hands. Girth 63 to 64 inches.
Light draught mule. 15 to 15 : 2 hands, weight 1,100 lb., girth 69 inches.
Riding pony for light artillery. Active Welsh cob type, not exceeding 15 hands.
Light greys are generally considered unsuitable.

The essential points are equable temperament, good middle piece, good legs and feet, strong back and good quarters. Leggy, flat-sided, "herring-gutted" horses and those with weak and badly shaped hocks, knees and fetlocks and unsound feet soon fall victims to active service conditions.

Many people stress the necessity for plenty of bone. That is all very well up to a point, but the important factor is the quality of the bone—hard, clean bone, even if not very big, is the desirable kind. It reminds me of the owner of a mule rejected by a purchaser whose idea of bone went no further than quantity, who said: "Well, brother, I ain't never knowed that there kind o' bone t' break." It is scarcely necessary to point out that animals with that kind of bone are relatively free from periostitis and ostitis, and, moreover, their cleaner joints stand wear and tear much better than those with heavier bone.

The purchasing veterinary surgeon is fully justified in rejecting animals that are "overshot," "undershot" or suffering from any other dental defect, or that are bad doers. Such animals soon find their way to the hospitals; hard work, trying conditions, and short rations soon tell the sad story. The late Sir Frederick Smith drew attention to the fact that the smaller, stocky horses stood war conditions better than the larger ones because of the smaller quantity of food required and the less time necessary to consume it.

Let us now glance at the breeds and types of horses and mules best suited for military purposes.

The Heavy Draught Horse.—The best heavy draught horse is undoubtedly the Shire when bred in his natural habitat—Great Britain. Those I have met with, bred in other countries are not nearly up to the standard of those produced at home. This is also true of other breeds of horses, but perhaps to a lesser extent. Again, one sees that the late Sir Frederick Smith was right with regard to the size of horses during a state of war, for the Shire requiring a large and bulky ration and time to consume it to keep him in good working

condition, is only useful for the heavy work to be found at railheads, points of embarkation, etc. Furthermore, on account of his sensitiveness to change of climate and environment, as well as his tendency to pulmonary disturbance, it is essential to give him time to become acclimatised. I have a great antipathy to hairy legged horses, and the "feather" of the Shire and the Clydesdale, however attractive it may be under favourable conditions, is a great drawback during war-time service. One, therefore, sums up the Shire horse as only fit for military service for special heavy duty in favourable conditions and when there is time for acclimatisation.

The Clydesdale, as stated above, shares the disadvantage of his "feather" and the variations in conformation, but so long as the type purchased is restricted to the smaller, stocky, active, cleaner-legged animals they will, as in the last war, give an excellent account of themselves in reasonably proper places. The leggy, flat-sided, light-barrelled specimens should never be bought if it can be avoided. They are also even more prone to "grease" and other forms of dermatoid disease than the Shire and the type mentioned above. The Clydesdale mare crossed by the thoroughbred horse breeds the best type of "gunner" horse to be found anywhere. Australia breeds a fine type of Clydesdale that has proved its value in times of peace and of war, so that one may still regard Australia as a source of supply in this war if required. The disadvantage, of course, is the distance away.

The Suffolk Punch is a horse that seems to me to have suffered in reputation as useful for military purposes in time of war, simply because so many of them are "coddled." When they are bred to *really* work and inured to trying climatic conditions my experience has been very much in their favour. They are also steady, good tempered and good doers, physically strong and less prone to pulmonary disease than either the Shire or the Clydesdale. Their amiable disposition makes them favourites with the troops, with the result that they are over-indulged with food and dainties. They are to be found at home, in Canada and U.S.A.

The Percheron horse is not a particular favourite with us, but still he is a most useful heavy and medium-heavy draught horse, and has given a good account of himself in time of war. He is the progenitor of the Percheron cross-breed (with Clydesdale mares)—a heavy and medium-heavy horse so popular in Canada and the U.S.A., and of which we bought thousands in the last war. They are active, clean legged, good doers, good hard workers and capable of great endurance. They have good hard legs, clean joints and sound, open feet that stand up to the wear and tear of active service. One still sees a few that were bought in the Great War. Another advantage they have is that they stand all sorts of climatic conditions very well and are not so prone to pulmonary disease, especially if they are given reasonable time to become acclimatised. It appears to me that they combine the best qualities of the Clydesdale and the Percheron. They are still available in the farming districts

of Canada, and in the U.S.A.; those bred in Iowa, the Dakotas and other northern states are of an excellent type and as hard as nails.

Light Draught Horses.—I believe this class of horse is still described as one capable of drawing a load of 1,200 lb. for approximately 12 hours a day at a walking pace of three miles an hour and trotting at six miles an hour. That may be all very well in time of peace, but in time of war, animals, as well as men, have to put their best foot forward, and when forming an opinion of a horse's activity, pace, capabilities and stamina, one should not keep in mind the lesser requirements. The light draught is in far greater demand than the heavy one, and, alas, there is no longer the good old London bus horse to come to our aid. All that remain are happy memories of him conveying all and sundry, and the conductor's "Benk, Benk, City Benk! Marble Arch, Oxf'd Circus, Charing Cross! Benk, Benk, City Benk!"

The light draught horse is used for: (a) artillery, subdivided into wheelers (the heavier and more stocky), centres and leaders; (b) transport. The blocky, short-legged, active, strong-backed and good-quartered type of horse is still to be found in fairly large numbers at home and in Ireland, and no doubt they will maintain the reputation of being unequalled for military purposes. Useful animals of this type are also to be found in the environs of the theatre of war, but it is doubtful whether neutral countries will part with them, for example, the Petit Percheron and the Ardennes horse. The light draught, and a very useful type, is still available in the east, middle west and northern parts of the U.S.A. and in Canada, which are our most accessible markets. I understand that of late years a very useful type of light draught horse has been bred in the Argentine, but I have had no experience of them.

Riding Horses, as previously mentioned, for military purposes are of two classes—those for cavalry and those for other units. That the best horses for these purposes are those bred at home and in Ireland will not be disputed, but when such horses are required in large numbers one has to go further afield to avoid buying a number of border-line animals. Although the indications at present point to but relatively few cavalry troop horses being required, and as these horses on active service are required to carry a load of nearly twenty stones, one realises that neglect of breeding and the prohibition of the excessive export of horses of this class have reduced the supply of them to danger point at home, and, unfortunately, they are not so plentiful in U.S.A. A few weeks ago we met with a collection of exceptionally fine horses destined for cavalry, but even as one paused to admire them, that outstanding undesirable point of over-height and all that it may mean cast a shadow over the scene. Let us seriously consider for a moment what that extra one or two inches in height and proportions means: first, a greater quantity of rations and additional time in which to consume them to maintain good health and hard-working condition; second, extra calls on transport of supplies and additional expense; finally, what it means to the man who has charge of him. We

who have been bred and born in the saddle know too well what that extra height means when a horse is restive, even if we are not weary after a hard day; but when one's muscles are sore and tired, time presses and through fear or restlessness one's horse is eager to go, that extra bit to surmount is highly magnified, and how much more it means to the trooper who is not an accomplished horseman, or may be suffering from wounds. Thus, it will be seen how important it is to keep size down to a minimum compatible with the requirements.

Until recent years the hunter type of horse was not bred to a great extent in Canada and U.S.A., and the nearest to the Leicestershire type of hunter was to be found in Montana and Wyoming. They were bred from Oregon mares by our classic thoroughbreds, and although some are still to be found in the West, a better market lies east of Kansas City. The reason for this is the popularity of riding and hunting found in the more eastern and some of the southern states, where riding clubs are the vogue. During the past decade many of our good-class hunter type of horses have been exported to meet the demand of the U.S.A. The Austrian and Hungarian horses, beautiful as some of them are, do not fulfil the requirements of our military riding horses for the reason that they are unable to stand the hardship of active service so well as our home-bred horses or those imported from Canada, U.S.A., Australia, New Zealand or South Africa, and it is doubtful whether they are obtainable at present. The "Waler" of the right type has proved to be a most useful animal for active service, but the distance and time required to import horses from Australia and also from New Zealand is against regarding these countries as convenient sources of supply.

The Australian "Bounder" is well named—a mixed-bred, ragged, weedy animal that finds a place in the cheap markets of India. Riding horses, class B, for units other than cavalry are fairly plentiful in our home markets, and the riding type of Welsh cob warrants the approval given to it. Good, sound feet and legs, short back, strong quarters and a good shoulder make him a comfortable ride; up to weight and the stamina derived from his native hills will carry him where less hardy horses would fail. An advantage, too, is that time for acclimatisation is not required as in the case of the Irish horse. Here let me say that "home markets" includes those in Ireland. When our own resources are being overtaxed once more must we turn to Canada and the U.S.A. and also to South America. The class B type of horse is more plentiful in those countries and the better bred ones are to be found where polo and riding are most popular, but for the sound, hard mounted infantry type one must still go to the prairie lands of the West, particularly to the middle west and south-west of Canada and the north-west of the States, where the more blocky and stronger type of riding horse is to be found. Those bred in the south-west are lighter in bone, narrower and show the old Spanish strain, but their stamina and endurance are astonishing to those who have had no

experience of them. During the " round up " a good " cow pony " will start the day soon after sun up, carrying a man weighing up to 200 lb. (wearing heavy chaps), a heavy stock saddle, with a slicker (oilskin) slung across the cantle, one or two lariats on the pommel and sometimes a rifle in its bucket. The day is seldom finished before sundown, and I have seen times when cattle and horses have given us trouble in the scrub, darkness was over us before we could drive them to the bedding place. It is difficult to say how many miles one covered in the time, but from point to point I, personally, have on several occasions had to cover from 100 to 120 miles in the day without my pony showing signs of distress or great fatigue. Here one may say that the Basuto pony is still more remarkable for his stamina and endurance, as manifested during the Boer War. In Arizona, New Mexico and Texas there are still, I believe, horses of the Cayuse type, and from our point of view they are better left where they are. The Argentine has devoted considerable time and money during the past decade to the improvement of their horses, and there is no doubt that it is a good market for riding horses if one uses discretion. Experience of their polo ponies is not unfavourable, and I believe it is also a market for a useful type of light draught horse, but I cannot speak from personal experience of the present-day product. One great drawback to the horses from the west of N. America and from S. America is that most of them are grass fed; indeed, some of them have never tasted grain and have no idea what to do with it when it is placed before them. To accustom them to change of diet and acclimatisation requires considerable time if the best results are to be obtained, and a great deal can be done with that object in view during their transit. They should be as fit as possible at the time of embarkation.

As the markets for Remounts are more limited than in other wars, no good purpose will be served by giving details of the classes and supplies in other countries, for if other nations become involved in the present conflict it will mean depending on what one may term local markets for whatever animals are required.

Ponies.—For mounted infantry work, detachments, etc., the pony from 13 : 3 to 14 : 3 hands is a very useful animal in time of war, especially as he requires a smaller ration. There are plenty of useful ones to be found at home to meet present requirements, and, until recently, some quite nice ponies arrived from Russia. India, South Africa, etc., are able to supply their own. Those of South Africa, such as the Basuto pony, the Cape and Free State ponies are well known for their stamina and the great distances they can cover, carrying weights out of all proportion to their size. The Indian ponies do not stand up to hard work and limited rations and unlike the Indian mule soon go under.

Mules.—" When de Good Lawd made de nigger he jest had to make de mule." Surely there never was a war in which the marvellous qualities of

them both did not come to the surface. Those of us who have lived amongst them know that the two harmonise so well, and understanding them leaves a tender spot and respect for them in our hearts: the "good in them is oft interred with their bones." There are many kinds of mules, ranging from the fine upstanding sugar mule, with clean-cut, sound limbs and a coat as fine and sleek as satin, to the little pack mule, sleek and clean, a real little pet with the latent speed and accuracy of a bantam-weight in a title fight. Unless he has undergone phenomenal metamorphosis, the only mule of my acquaintance that is not fit for military purposes when bought out of work is the big team mule of California—a fine, big, heavy draught animal that, as they say, "will shift the side of a house." He has been schooled as far as it is possible to school him in a certain way by a certain class of man; he will never understand us and we will never understand him, so we are far better apart. In no circumstances would I recommend buying him for military purposes—he is a killer. At one time the Texas mule was difficult because he was so rarely handled, but nowadays he is more tractable. Those of the middle north, the middle west and the south of the U.S.A., particularly the latter, are gentle and very tractable if one handles them properly, but having more sense than most horses, they naturally resent the roughness of the tyro and are cute enough to know when they can be top dog. The mule, as most of us know, will thrive where a horse would starve. Like the negro, to get the best out of them they must be kept happy and "jollied along." To keep them in the best condition mentally and physically they must have freedom to roll when the gear is removed and should be fed loose in a pen when possible.

In my opinion, there is none better than the American mule.

When my services were retained to proceed to Belgium, report on the organisation dealing with the matter of the old war horses and to buy as many of them as possible while I was there, I, like everyone else, was astonished to find horses, and particularly mules, still working in dreadful conditions, showing various degrees of lameness and deformity. Some of them had been passed by myself in 1914, and it is hard to believe that any animal could possibly have survived so many years of hard work in such a state of suffering and scant rations.

The heavy draught mule often measures 17 hands and weighs over 1,400 lb., but for military purposes those chosen in the Great War were 16 : 1 to 16 : 3 hands, weighing not less than 1,250 lb. Most of them were bred in Missouri, Oklahoma and the South and were the type chiefly used on the sugar plantations, lumber camps and for heavy transport along the levees of the Mississippi and Ohio rivers. They gave an excellent account of themselves as workers and were less trouble to the veterinary staffs on account of their freedom from pulmonary diseases and lameness.

The light draught mule stands 15 : ½ to 15 : 3 hands with a weight of not less than 1,100 lb. Discretion concerning weight may be used, having regard

to the mule's breeding, for a 15 : 2, 1,050-lb. good type of Texas mule may be the equal of a 15 : 3, 1,150-lb. Missouri mule on account of his finer breeding and harder life. In my judgment the best mules of recent years are bred in Iowa and the Dakotas. They are very similar in conformation to the stocky, stronger type of Missouri mule, but are more active, hardier and even more tractable. They are not nearly so numerous as the Missouri mule because of later breeding and popularity. The light draught mules bred in Alabama, Georgia, Kentucky, Tennessee and the Virginias are a finer quality than those bred farther north, west and south-west because of the prevalence of better-bred mares, especially in the blue grass country. Many of them, but for their long ears, resemble sleek, thoroughbred horses. They cannot be beaten for light draught work.

The heavy pack or transport mule measures roughly 14 to 15 hands, is short-coupled, with a strong, straight back, is active and must have good legs and feet. The Missouri mule is the best type. The light pack or transport mule, mountain battery mule and equipment mule vary from 13 to 14 : 1 hands and are of the usual type for pack work. The small transport, draught and pack mule is from 12 : 1 to 13 : 3 hands, of good quality and has the usual conformation required for that class of service. The small mules are also to be found in the south and south-west of the U.S.A. Many have been shipped to India during the past 40 years, which goes to prove how greatly they are appreciated, although the breeding of mules is carried on to a considerable extent there. The small mule is also available in South America, particularly in the Argentine, in China, North Africa and the Latin countries. One great advantage the mule has over the horse is that he suffers less from foot trouble and, except on hard road work, seldom needs shoeing so long as his feet are kept properly trimmed. They are also quicker to sense danger and unsafe going.

Donkeys.—The donkey is one of the most useful means of transport in war when properly looked after and treated well. During my sojourn in India, Egypt and Palestine many of them came under my charge, and, but for the result of improper treatment by private owners, they gave so little trouble that professional services were scarcely necessary. They are not likely to be required at home to any great extent, and there is a good market in the East when they are needed.

Bullocks, Elephants and Camels all have their great value in their own spheres during times of peace and war, but they are not within the scope of this paper.

In bringing this sketchy dissertation to a conclusion, let our members who are called to Remount Duty remember to stick to their guns and not be dissuaded or coerced from their strict duty, but to bear in mind the power that lies in an advisory capacity. If anything occurs in the way of the spread of disease, avoidable causes of accidents or delays through even senior officers

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being allowed to act contrary to the better judgment of the veterinary surgeon through weakness on his part, it will not be the senior officer who will suffer most. As the Yankees say: "Be sure you're right, then go ahead." Usually one's relations with all concerned, Remounts, railway people, shipping representatives, contractors, muleteers, etc., are happy and more or less amicable, but sometimes they are the reverse, and it is then that one must not give way. Let me cite an incident of my own experience to illustrate more clearly the point I wish to emphasise in upholding the status of the profession and of one's appointment.

The Commandant of the depôt was removing a shipment of horses that had just arrived to a depôt in which there had been a case of glanders. By chance I met him riding in the lead and inquired where he was taking them. When he told me I pointed out why they should not be taken to that depôt, and was duly informed that he was in command and would do as he liked. My answer was to the effect that if he put so much as the nose of one horse inside that particular depôt, contrary to my advice, I would report the matter direct to the War Office. He followed the advice. One can see quite plainly what might have happened to me and my professional reputation had I been weak. One never knows when one may meet with people of that type, and a young man may feel that he must cede a point or so to lay seniority. My advice is, never to do so where contagious disease and unsoundness are involved.

THE STUDY OF COCCIDIOSIS (EIMERIA CAVIÆ [Sheather 1924]) IN THE GUINEA PIG

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PART I

Introduction

In 1937 outbreaks of acute coccidiosis occurred in the guinea pigs being used in this Institute and a series of observations on them was then begun and continued, in the intervals of other work, until the end of 1939. The general result has been confirmation of the work of the relatively few other workers who have written about this species.

Historical

Labbé (1899) appears to have been the first to record coccidia in the guinea pig. He records them as a variety of *Coccidium perforans* and says of them that they are small coccidia, not entirely known, occurring in the intestine of *Talpa europæa* L, *Cricetus cricetus* L, *C. frumentarius, Mustela vulgaris, Cavia cobaya.* Sheather (1924) states that Lerche (1920) refers to coccidia in the guinea pig in a thesis on coccidiosis of sheep, published in Hanover. Strada and Traina (1900) described a coccidium in guinea pigs in Pavia, Italy, which they called *C. oviforme.* Bugge and Heinke (1921) studied coccidiosis in guinea pigs obtained from various areas in Germany for their Institute at Kiel and found it in 75 per cent. out of 180 guinea pigs examined. They described the oocysts and their sporulation and some of the clinical and pathological results of infestation, and published photographs of the oocysts. Sheather (1924) published a description of the life-history of coccidia he found in a guinea pig purchased for experimental work, the oocysts from which he fed to other guinea pigs. He identified this coccidium as a species of *Eimeria,* to which he gave the name *E. caviæ.* Wenyon (1926) briefly summarised what was known of *E. caviæ* at this date, when his book was published. Henry (1932) studied *E. caviæ* in natural and experimentally produced infestations and described a series of very interesting experiments on resistance to the parasite and on the allergic reactions to it. Kliesch (1933), who re-edited Ræbiger's (1923) book on the breeding and diseases of guinea pigs, gave a short account of the parasite and the disease it may cause. Becker (1934) gives a short, but compact and valuable, account of what is known of *E. caviæ* up to this date.

Incidence

Most of the authors who have studied *E. caviæ* state that it is common in guinea pigs used for biological work, but rarely causes death.

Labbé (1899) does not say anything about its incidence, neither do Wenyon (1926), Sheather (1924), nor Becker (1934). Strada and Traina (1900) state that their study of pneumonia of guinea pigs showed that coccidiosis and pseudo-tuberculosis occurred in relatively few cases of pneumonia. Earlier in their paper they say that coccidiosis and pseudo-tuberculosis were common in the guinea pigs they used, but it is not clear from their paper whether they mean that both or either are common. Kliesch (1933) re-editing Ræbiger (1923) concludes from a brief review of the literature that coccidiosis occurs in many experimental guinea pigs. Bugge and Heinke (1921) found that 73 per cent. of 180 guinea pigs examined from the region of Kiel and other centres in Germany harboured coccidia, so that they regard the infestation as common and widely distributed. The author's experience is that it is just as common and widely distributed in England. All the guinea pigs examined by

him were 4-5 months old and were supplied by three different breeders whose establishments were in widely separated districts of Southern England. The guinea pigs supplied by one of these breeders were so frequently infested and they so often developed heavier infestations after their arrival that the Institute was unable to use them for experimental work, although they were a convenient and reliable source of *E. caviæ*. Henry (1932) does not state how common she found the infestations to be in the American guinea pigs which she used, half of which were "raised in the animal colony of the Department of Zoology, University of California," the other half being derived from an unspecified source. The fact that she had no difficulty in obtaining material suggests that *E. caviæ* is no less common in America than in Europe.

The information that we have about the incidence of *E. caviæ* suggests, therefore, that the majority of normal guinea pigs reared for laboratory use are infested and are passing from time to time some oocysts.

Material and Methods

(A) *Method of examination for oocysts.*

At the beginning of the investigation the guinea pigs were examined for oocysts by emulsifying their fæces in water and searching this emulsion microscopically for oocysts. Of 25 healthy guinea pigs given one direct fæcal examination of this kind on one day only, 40 per cent. showed oocysts. This method was soon abandoned because careful search through sections of the colons of guinea pigs which were negative by this method revealed oocysts in the mucosæ of the colons of a number of them. Sheather's centrifugal sugar flotation method, used also by Henry (1932), was therefore adopted. This method resembles the direct centrifugal flotation method devised by Clayton Lane (1922) for the detection of nematode eggs in fæces. Andrews (1930) has modified this method for the diagnosis of coccidiosis. The writer's adaptation of it was to emulsify the fæces in water and strain them through gauze. The filtrate was then mixed with an equal volume of saturated solution of sugar (1 lb. sugar to ¾ pint water) and centrifuged at 2,000 r.p.m. for a few minutes. Portions of the surface layer were then removed with a platinum loop and searched for oocysts.

Of 57 healthy guinea pigs examined daily for considerable periods by this method, 91 per cent. were eventually shown to be passing oocysts. They were therefore potential sources of infestation.

The importance of repetition of these examinations is shown by the records of only 10 daily examinations, by Sheather's centrifugal flotation method, of 45 healthy guinea pigs, all of which proved eventually to be positive. The first examination detected oocysts in 28 of them (62.2 per cent.); on the second day oocysts were found in five more (11.1 per cent.); on the third day seven more were positive (13.3 per cent.); on the fourth day no more were positive;

on the fifth day three more showed oocysts (6.6 per cent.); on the sixth day oocysts were found in the remaining two (4.4 per cent.). Guinea pig 141, moreover, examined daily by Sheather's method, was negative every day until the fifth day, when only eight oocysts were counted; it then remained negative for three months. Guinea pig 132 was negative for 10 days, when a few oocysts appeared; it was then again negative for 20 days, when a few oocysts were again found. These two guinea pigs never developed an attack of coccidiosis and it could be argued that the reason why 132 occasionally passed a few oocysts was that it was infesting itself in the wire cage in which, like all the others, it was isolated. It cannot be denied that some self-infestation normally occurs when animals are isolated, especially when we have the proof given by Taylor (1939), Madsen (1939), Murot (1882) and Eden (1940) that rabbits normally eat their own fæces. It is likely that guinea pigs also do this. But guinea pig 141 remained negative for three months, so that isolation was, in this instance, apparently effective.

It can be argued further that these guinea pigs did not develop coccidiosis because they were resistant. Tyzzer, Theiler and Jones (1932) found, in partially resistant chickens, slight infestations with species of *Eimeria* which "were not demonstrable by microscopic examinations." The detection of the oocysts in the fæces, moreover, did not prove that the oocysts were coming from the mucosa of the colon of the animal examined. They might have been passing through the intestine unhatched. Tyzzer (1929) showed that oocysts of the species of *Eimeria* which he studied in chickens may do this. The only method of making sure that the oocysts being passed are coming from the mucosa of the animal passing them is to cut sections of its intestine and examine them for coccidia. The writer's experiments with frozen sections have shown that, by this method, sections can be obtained within two hours or less, in which oocysts, gametocytes and other stages of the parasite as well, can be recognised in the cells of the mucosa, even though the material is not fixed at all before it is frozen. The fact, however, remains that persistent daily examination of isolated animals by a centrifugal flotation method does frequently reveal the presence of oocysts in animals in which only a few such examinations have failed to detect them.

It would appear, therefore, from the writer's records, that at least six daily examinations by the flotation technique should be made before an animal is regarded as probably negative. Other guinea pigs remained negative for longer than six days, so that it is best to continue the daily examinations longer than six days. We have, in other words, to recognise that it may be very difficult, or even impossible, to say that any given guinea pig taken from normal stock or bought from a breeder is not infested with *E. caviæ*. That is also true of other intestinal parasites. It is the normal experience of most protozoologists and helminthologists. The writer's experience of fæcal examinations during the war of 1914-1918 for the cysts of *Entamœba* and for helminth eggs and his subsequent experience of similar examinations of

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animals for helminth eggs, has certainly been of this kind. Even if young guinea pigs should be reared without contact with their mothers and precautions should be taken to protect them from other sources of infestation with *E. caviæ*, it would still be very difficult to pronounce them "clean." This fact must be remembered when work on resistance to *E. caviæ* is undertaken. Henry (1932) says that, after those of her guinea pigs which had recovered from coccidiosis "had been shown to be free of cysts by at least two examinations," using Sheather's centrifugal flotation method, she removed them to another room until they were reinfested. She took great care to prevent accidental infestation of the animals she used; she kept them in auto-claved cracker tins, ensured that the assistant in charge of them had no access to the other guinea pigs and did everything possible to control infestation; but, if she regarded two examinations by Sheather's method as proof of freedom from infestation, it is doubtful, in the light of the observations just recorded, whether these were sufficient to prove that her animals were "free from cysts"; and this doubt must influence our estimate of her work on resistance to *E. caviæ* and the allergic reactions associated with it.

(b) *Isolation and Feeding of Guinea Pigs.*

All the writer's guinea pigs were isolated in open wire cages and were given water and were usually fed with bran and whatever green stuff was available, a diet which kept them in good condition. It corresponded with the diet of rolled barley and lawn clippings or lettuce on which Henry (1932) kept her guinea pigs healthy. At intervals, attempts were made to induce acute attacks of coccidiosis by feeding only coarse grass to animals which were passing oocysts, but it was never possible to cause an acute attack in this way. The mild attacks which some of these poorly-fed guinea pigs developed lasted only a few days and did not produce visible symptoms. The attacks usually began soon after the arrival of the animals from the breeders and may have been induced by chills, etc., contracted on the journey or by the change of diet. Poor feeding over several weeks never induced them once the animals had settled down. Bugge and Heinke (1921) found coccidia in great numbers in guinea pigs in their Institute at Kiel when the feeding of laboratory animals was poor owing to the restriction of supplies during the war of 1914-18. In this instance the prolongation of poor feeding may have lowered the resistance of the guinea pigs to the coccidia, but the writer's failure to induce attacks by poor feeding shows that, if poor feeding is to predispose guinea pigs to this parasite, it must be continued for some months. The relatively feeble pathogenic powers of *E. caviæ* indicate that the host is usually well adapted to it and can resist it well.

Post-mortem examinations were made of all the guinea pigs that died and of those which were killed after they had been fed with oocysts. The livers never showed any naked-eye evidence of disease, nor did any part of

the alimentary canal except the colon. For this reason the colons only were fixed for sectioning.

(c) *Method of counting the oocysts and feeding them to guinea pigs.*

The guinea pigs were all fed *per os* with a pipette, all the dose being given at one feed. Henry gave three feeds with a pipette on three successive days, in order to avoid feeding a large amount of material at one time, which is, no doubt, a wiser procedure. She strained her oocysts through wire gauze and thoroughly washed them in normal saline before feeding them. Like Sheather (1924) she did not determine the total number of oocysts fed to her guinea pigs, but was content to make sure that a large number of sporulated oocysts were present in the dose given.

The writer's sporulated oocysts were centrifuged down in the fluid in which they had sporulated and then were repeatedly washed with water in the centrifuge before they were fed. The total number of sporulated oocysts was determined before they were fed to all the animals except a few fed when the experiments first began. When sporulation appeared to be complete, the centrifuged oocysts were mixed with 100 cc. water and the number present in 0.1 cc. of this, multiplied by 1,000, gave an approximate idea of the total number of sporulated, unsporulated and partially sporulated oocysts present. A differential count of two hundred of these then gave an approximate percentage of the total number of sporulated oocysts in the material given to the guinea pigs.

It was not, of course, possible to be certain that all these were ingested by each animal, nor that all of them liberated their sporozoites inside the animal fed. Tyzzer (1929) did not count the number of oocysts of species of *Eimeria* which he fed to chickens, pointing out that the number fed can be at least only a rough index of the actual dosage, because a variable proportion will always pass through the host unhatched. Feeding with a pipette does, however, as Henry (1932) points out, enable one to be more certain that more of the dose is ingested than if the oocysts are mixed with milk or food. Andrews (1930) discusses various methods of giving the dose.

(d) *Histological Methods.*

An adequate study of the morphology of any biological material requires not only comparison of the results obtained with different fixatives, but also comparison of the results given by combinations of different stains with these fixatives (cf. Part II). For this reason, the following fixatives and stains were used :—

Fixatives :—

Formol-saline, Duboscq-Brasil modification of Bouin's picro-formol (alcoholic Bouin), Flemming's osmic-chromic mixture (weak formula) without acetic, Helly's sublimate-bichromate-formol, Heidenhain's " Susa " mixture

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of sublimate, formol, acetic acid and trichloracetic acid, Zenker's sublimate-bichromate-acetic, Dobell's (1925) sublimate-formol, (three parts of a saturated aqueous solution of corrosive sublimate and one part of formalin containing 40 per cent. formaldehyde), Carleton's (1926) sublimate-formol (90 cc. of saturated aqueous solution of corrosive sublimate and 10 c.c. of 40 per cent. formalin) and a saturated solution of corrosive sublimate containing 5 per cent. of glacial acetic acid. The formulæ for all these were taken from Gatenby and Painter (1937), excepting that of Dobell's (1925) mixture.

Stains:—

Delafield's hæmatoxylin.
Mayer's hæmalum.
Mallory's phosphotungstic hæmatoxylin.
Weigert's iron hæmatoxylin.
Ehrlich's acid hæmatoxylin.
Jannsen's hæmatoxylin.
Azocarmine.
Heidenhain's Azan.
Mallory's triple stain (acid fuchsin followed by anilin blue and orange G).
Picronigrosin.

Helly's mixture was the best of the fixatives; it was the only one which did not produce shrinkage of the tissues round the parasites. Measurements of this shrinkage space, and of the parasites within it, showed that none of the fixatives produced any appreciable reduction in the size of the parasites; the shrinkage was always chiefly in the tissues surrounding them.

The standard stain for general purposes and for the study of detail was Heidenhain's aqueous iron hæmatoxylin, both the short and the long method being used. The hæmatoxylin solution employed for it was ripened by Shortt's (1923) rapid method of boiling a 1 per cent. solution of hæmatoxylin and adding to 95 cc. of it 5 cc. of pure carbolic acid. This gives as good, and sometimes better, results than the aqueous 0.5 per cent. hæmatoxylin ordinarily ripened in the sunlight, but has perhaps a greater tendency to produce the kind of artefacts that are discussed in Part II. The stock solution of 1 gm. hæmatoxylin per 10 c.c. absolute alcohol, diluted to 0.5 per cent., recommended by Gatenby and Painter (1937), also gave good results. After Helly's fixative, differentiation of iron hæmatoxylin was much more rapid than after the other fixatives used. Weigert's iron hæmatoxylin, Mallory's phosphotungstic hæmatoxylin, Delafield's, Jannsen's and Ehrlich's acid hæmatoxylins were all inferior to Mayer's hæmalum, which was a very useful stain. It was differentiated with 0.25 per cent. conc. HCl in water, followed by 1.25 per cent. ammonia in water to blue it. It proved to be the best stain of all for the merozoites and schizogony bundles, which, for some unascertained reason, did not retain Heidenhain's iron hæmatoxylin well; when they were well stained

with this, the tissues around were so heavily overstained that they obscured the merozoites. The other stages in the life history did not behave in this manner, so that it is possible that some difference in the chemical composition of the merozoites, resulting perhaps from a physiological difference between them and the schizonts and sexual stages, was responsible for their different staining reaction.

For the general demonstration of the parasites in the tissues and for the differentiation of muscle, connective tissue, goblet cells, etc., in the colon, Heidenhain's azan stain (Gatenby and Painter, 1937, Romeis, 1932), suggested to me by Dr. L. E. R. Picken, of the Zoology Department, University of Cambridge, gave very brilliant and pretty results. Varying degrees of differentiation of it give various degrees of red and blue colour. In general, the nuclei of the tissues stain red, the muscles of the intestinal wall orange, the goblet cells in the epithelium blue to purple, the connective tissue blue, the red blood cells pink or red. The coccidia are usually clearly picked out by the stain, especially the oocysts and the male and female gametocytes. In the female gametocytes the granules are especially brilliant in red or orange or yellow (see Part II). The protoplasm inside the oocysts is usually blue and the layers of the oocyst wall are well brought out in yellow to orange or red; if the sections have not been differentiated for long, the outermost wall of the oocysts retains some of the anilin blue. All these colour reactions vary, however, according to the duration of the staining and the anilin blue and orange G stain is rapidly removed during the dehydration of the sections, so that differentiation is, like that of Mallory's triple stain, difficult to control and some skill is required if approximately uniform results are to be obtained. Probably the variable results are due to the factors indicated in Part II. The use of the stain also involves jumping the slides more than once in the course of the staining from high grades of alcohol direct to water and back again, so that detail is apt to suffer and the definition may not be as clear as it is when other methods are used. The stain is, however, certainly excellent for general purposes and gives very striking results for the demonstration of the number and position of the parasites, their relation to the tissues and the degree of the infestation. The most brilliantly coloured sections are obtained after sublimate fixatives. After fixatives containing chromate, washing out of the fixative must be thorough.

Mallory's triple acid fuchsin, orange G and anilin blue also demonstrates the parasites very well. It colours the parasites and tissues much as the azan stain does and is very useful for staining the layers of the oocyst wall; but the colours it gives are not so brilliant and they tend to fade more quickly in permanent preparations. Pico-nigrosin was also tried as a means of staining the walls of the oocyst, but was not so successful as Mallory's triple and the azan stains.

Some of the slides were mounted in the new medium Clarite, formerly

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called Nevillite, recently introduced by the Neville Co., of Pittsburgh, and described by Groat (1939). This mounting medium is certainly excellent, but it is as yet too early to say whether it can affect the colour of sections stained with stains like Mallory's triple stain or Heidenhain's azan.

Sporulation of the Oocysts

Bugge and Heinke (1921) studied this by streaking pieces of the mucosa of the colon in a thick layer on blotting paper and keeping this in a moistened Petri dish with boric acid or thymol to keep down the bacteria. They say that at room temperature on the second or third days the protoplasm in the oocysts had withdrawn itself from the wall of the oocyst to form a ball in the interior. In the margin of this ball indentations appeared, from which refractile lines spread inwards and the protoplasm then divided into four sporoblasts, a residual body being left over. These sporoblasts then elongated and two sickle-shaped, slightly curved sporozoites appeared inside each of them. Sporulation was complete in 5-8 days at room temperature. Sheather (1924) found that in 5 per cent. potassium bichromate solution at room temperature in a Petri dish sporulation had begun by the fourth day. On the fifth day 20 per cent. of the oocysts had completed sporulation. He found that oocysts from different guinea pigs required different times to complete sporulation, the range being 5-8 days, which confirms the observations of Bugge and Heinke. One batch of oocysts had, for a reason which Sheather could not explain, failed to sporulate by the end of a fortnight. The writer has also found that occasionally all the oocysts from certain guinea pigs fail to sporulate. Henry (1932) mixed the fæces or the intestinal contents of guinea pigs with 2 per cent. potassium bichromate solution and incubated them in Petri dishes. Sporulation began in 24 hours and was complete in 2-3 days. It also occurred " quite readily " in normal salt solution. It is evident that the higher temperature employed shortened the sporulation time.

The writer mixed oocysts with 2 per cent. potassium bichromate in Petri dishes, a shallow layer only being used in order to allow as much oxygen as possible to reach the oocysts. Other batches of oocysts were similarly mixed with 1 per cent. formol, plain water and with a 1 in 20 dilution of Milton hypochlorite in water, which makes a dilution containing approximately the same amount of NaCl as normal saline. All these solutions were kept at laboratory temperature only (about 18-22 deg. C.). Sporulation proceeded in all of them at about the same rate. The peak of it was not reached until the ninth to the eleventh day, a time which corresponds, having regard to possible differences of laboratory temperature at different times of the year, with the 5-8 days recorded by Sheather (1924) and by Bugge and Heinke (1921). On the ninth day, for example, differential counts of sporulated, partially sporulated and unsporulated oocysts of a batch of oocysts which had not been aerated showed that 81 per cent. had sporulated in water, 81.6 per cent. in

Milton. The only disadvantage of plain water seemed to be that bacteria and moulds developed more readily in it, the moulds entangling the oocysts in their hyphæ.

The Milton solution was tried because other experiments on the liberation of the sporozoites in artificial gastric and pancreatic juices had shown that, if the sporulated oocysts are first treated for 12-24 hours with a mixture of one part of Milton in nine parts of water, a larger percentage liberate their sporozoites in the pancreatic juice. Further experiments on this point are proceeding and will be recorded in another paper. Examination of sections of the colon indicated that the feeding of oocysts sporulated in Milton did not give rise to a heavier infestation than the feeding of oocysts sporulated in 1 per cent. formalin or in 2 per cent. potassium bichromate.

Other batches of oocysts were aerated with a Mark II Dinton aerator in glass tubes in sterile water and in a 1 in 20 dilution of Milton with water and in 1 per cent. formalin, with controls in the same fluids not aerated. The aeration did not appreciably reduce the time required for sporulation, nor did it appreciably increase the total number of oocysts that completed sporulation.

In all the fluids used, whether they were aerated or not, 60-70 per cent. of the oocysts completed their sporulation in 9-11 days. In the aerated fluids a slow and slight rise continued after this, but there seemed to be no advantage in aerating them, if 60-70 per cent. would sporulate without aeration.

It appears, therefore, that although oxygen is necessary for sporulation, enough is present for its completion in shallow layers of water and more need not be provided. It is possible, indeed, that too much oxygen, supplied by artificial aeration, may do more harm than good and may even kill some of the oocysts. The number of sporulated oocysts, ascertained by differential counts of 200 oocysts taken from each unaerated dish, did not appreciably increase or diminish after the eleventh day, though the oocysts in some of the dishes were counted as long as 48 days after sporulation had reached its peak.

The temperature used for the sporulation of oocysts in the laboratory must always be an important detail to be noted and controlled. Becker (1934) quotes only Henry's (1932) sporulation time for *E. caviæ* and omits to mention that she incubated the oocysts she observed. Henry herself omits to state the temperature she used. She observes, however, that she (1931 and 1931a) and Tyzzer (1929) have established the fact that the sporulation time is constant for each species and can be used as a character for the determination of species, but that, if it is to be so used, the same method of treating the oocysts must be used by all workers. She also points out that other variables in the medium used should also be controlled, such as the *pH*, the relative quantities of fluid and solid, the gas tensions, and so on, and that, when the oocysts of two different species are being compared, these oocysts should be in the same container. It is evident that there is room for much more work, by a worker trained in physico-chemical methods of investigation, on this problem. It

might well be correlated with work on the nature of the membranes enclosing the contents of the oocysts, similar to that done by Henry (1932a), by the other workers quoted by her in that paper, by Cheyssin (1935) and by the others whose work Cheyssin quotes; it might also be correlated with work on the liberation of sporozoites from the oocysts. The writer's preliminary experiments on this latter subject suggest that the effect of hypochlorites on the membranes of the oocyst wall might yield interesting results.

(*To be continued.*)

THE RELATION BETWEEN SKIN MEASUREMENTS AND THE CHARACTER OF THE SWELLING IN ELEVEN HUNDRED DOUBLE INTRADERMAL TUBERCULIN TESTS

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It is, at present, the generally accepted view that the character of the swelling in a tuberculin reaction is the essential criterion by which the result should be judged. This view takes little or no account of the increase in the thickness of the skin fold which can be ascertained by accurate measurement, but leaves the decision to individual judgment. Opinion unsupported by other concrete evidence may, therefore, be limited only by the number of observers making the examination.

It can be shown that a significant number of animals exhibiting swellings of a typically negative character also give measurements falling within a consistently narrow range. It can be postulated, therefore, that a relationship exists between skin measurements and the character of the swelling in typically negative cattle.

Similarly, it can be shown that a significant relationship exists in the positive range between skin measurements and the character of the swelling.

Between the typically negative and positive groups there lies a smaller group of animals which give swellings and measurements of an atypical character. Sometimes it is impossible to assess these results accurately. A further test may give a typically negative or positive reaction, or it may yield still another indefinite result.

These observations are based on the results of over eleven hundred tests

performed mainly in herds qualifying for Attestation. A few post-attestation tests are included. The tests have been made at the neck site, and Camden Town Tuberculin of various batches has been used.

Technique of the Test

In any attempt to establish a relationship between the character of the swelling and the skin measurements it is essential that the technique should be so standardised that every step in the procedure becomes automatic in practice.

Syringe.—The 1 c.c. dental pattern syringe has been used because it is convenient to handle and the rubber piston provides sufficient friction to prevent movement between injections. It is certain that tuberculin and not air is introduced when the injection is made. The graduated piston rod with set screw ensures that accurate and comparable doses are given.

Needle.—An interchangeable dental needle, No. 16, $\frac{1}{8}$ inch long, carried in a long screw on mount has been used. When fitted to the syringe, the needle projects 6 mm. beyond the mount.

It can be shown that if the needle is introduced into the skin fold at an angle of approximately 30 degrees, the tuberculin will be deposited in the deeper layers of the dermis. This consideration is satisfied in practice when the back of the hand carrying the syringe touches the skin of the neck, while the other hand raises the skin fold to receive the injection. Proof that the injection has been made *into* the skin is obtained by light palpation with the finger tip. The fine needle causes the minimum of traumatic injury to the skin and provokes little resistance from the animal.

Calipers.—A rigid and accurate instrument is indispensable if measurements of any value are to be obtained. A screw micrometer gauge reading to 0.01 mm. is a convenient and simple instrument, with which it is possible to repeat measurements with an error of less than 0.5 mm. Moreover, different observers can obtain readings within the same degree of accuracy. The common bow caliper reading only to 2 mm. is quite unsuitable. It is impossible to record accurate measurements with this instrument. Such measurements must be discounted as of little value.

Site of Test.—The orthodox neck site has been used. It is important to select an area of skin of uniform texture throughout. In cattle which have been tested repeatedly it is not uncommon to find irregularities in texture which may increase the difficulty in interpretation. Such irregularities may not be detected until the raised fold is examined prior to injection. In such a case a new site must be selected. All cattle in a herd have been tested on the same side of the body, and the opposite side has been used at the succeeding test. Thus, in short interval testing, an interval of at least four months has elapsed before a second test has been made on the same side of the neck.

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Interpretation of Results

The reading of the tests has been based on the character of the swellings, to conform to accepted practice, and the measurements have been correlated with these findings.

Negative Swellings.—Swellings which have displayed the character of a small discrete pea in the skin, without any diffusion, have been accepted as negative. In some cases the swelling has been almost imperceptible by finger tip palpation and has required careful palpation of the raised fold to detect its presence. A small proportion of negative swellings has been somewhat larger than as above defined, but still without diffusion.

Positive Swellings.—Diffusion, i.e., loss of definition at the margin of the swelling, has been the criterion by which positive swellings have been judged. These reactions have been recognisably larger than the typically negative swelling.

Discussion of Results

The detailed analysis necessary for the production of the tables has shown that the actual increase in skin thickness is the critical measurement. The increase bears no relation either to the age or the sex of the animal.

If the actual increase in skin thickness be correlated with the character of the swelling it can be shown, in negative cattle, that 93.4 per cent. do not exceed an increase of 2 mm. at 48 hours, and 90.6 per cent. do not exceed a total increase of 3 mm. at 72 hours.

In positive cattle the increase is greater than 3 mm. at 48 hours in 89.8 per cent. of cases, and at 72 hours, 91.1 per cent. of the reactors show an increase exceeding 5 mm.

The increase which occurs between 48 and 72 hours is more variable. This variation does not, however, affect the hypothesis.

In these herds qualifying for attestation the incidence of tuberculosis must be assumed to be low. In such self-contained herds the incidence of tuberculosis among the calves may be expected to be even lower than is the case among the cows. The increases in skin thickness recorded for calves show a correspondingly higher degree of agreement than cows with the hypothesis. It seems, therefore, that the calf results may give a truer picture of what is to be expected in a tubercle free herd.

Atypical Results

Total increases lying between 3 mm. and 5 mm. constitute an atypical group which may contain both negative and positive animals. Table I shows that 9.4 per cent. of non-reactors and 8.9 per cent. of reactors come within this group. It is impossible to assess the true status of all these animals on the result of a single test.

DOUBLE INTRADERMAL TUBERCULIN TESTS

TABLE I

INCREASE IN SKIN MEASUREMENTS

Animals	NEGATIVE													POSITIVE												Total Tests
	48 Hours				72 Hours				Total Increase					48 Hours				72 Hours				Total Increase				
	Not over 2 mm.		Over 2 mm.		Not over 1 mm.		Over 1 mm.		Not over 3 mm.		Over 3 mm.			Not over 3 mm.		Over 3 mm.		Not over 2 mm.		Over 2 mm.		Not over 5 mm.		Over 5 mm.			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Total	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	Total	
Cows and Heifers	702	92.5	56	7.5	528	69.7	230	30.3	681	89.8	77	10.2	758	14	9.3	137	90.7	16	21.6	(77) 58	78.4	12	7.9	139	92.1	151	909
Calves under 10 months	164	96.5	6	4.5	134	78.8	36	21.2	159	93.5	11	6.5	170	2		4				6		2		4		6	176
Bulls	27		1		18		10		26		2		28														28
	893	93.4	63	6.6	680	71.1	276	28.9	866	90.6	90	9.4	956	16	10.2	141	89.8	16	20.0	64	80.0	14	8.9	143	91.1	157	1113

(77) Second Injections omitted

TABLE II

SUMMARY OF ATYPICAL MEASUREMENTS

Not Tested Previously	Previous Test Normal	Previous Test Atypical	Subsequent Test Normal	Reactors at Subsequent Test	Subsequent Test Atypical	No Subsequent Test	Total
26	53	11	57 (a)	5	16 (b) (c)	12	90

(a) One cow gave normal measurements at tests three and six months later, but reacted at nine months later.

(b) One cow remained atypical at three months later, but reacted at six months later. Both cows in the same herd.

(c) One cow remained atypical at three months later, passed two tests with normal measurements, but reacted 12 months after the first atypical result.

Measurements showing a total increase of 3.1 mm. and upwards have been shown as atypical.

At the upper limit of the range lie the large negative and the small positive swellings. In the latter the degree of diffusion may be slight. Animals classed as reactors have, of course, been removed from the herds, and their future behaviour is not known.

The large negative swelling showing a total increase near to that of the small positive may become ***unmistakably positive*** at the next test, or it may remain atypical and react at a later test. A further possibility is that such an animal may revert to the normal negative range for one or more tests, and still become positive later.

The number of animals lying near the upper limit of the atypical range in the present series is insufficient to establish any definite conclusion, but it is of practical importance to remember that animals exhibiting large negative swellings may become definitely positive after a longer or shorter interval.

The human error inherent in the process of measurement, although small, accounts for some of the animals lying near the lower limit of the atypical range, e.g., those which show a total increase of 3.1 or 3.2 mm. Such animals can usually be placed in the correct category without much difficulty. This is especially true for calves for the positive reaction in the calf generally is massive and unmistakable.

Table II shows that the majority of the atypical animals gave normal negative measurements at the previous test, and that the majority reverted to normal at the next test. A smaller number were atypical at the previous test and remained atypical at the subsequent test. Some of these animals became positive later, as shown in the footnote to the table. Finally, there is the group of five animals which became definitely positive two to three months after the atypical result.

It is not within the scope of this note to discuss factors which may have a bearing on the occurrence of atypical results. It is sufficient to emphasise that an atypical group exists, containing animals which may show a positive reaction after a short interval. In the interests of the herd this group must be regarded with suspicion.

Summary

An analysis of eleven hundred tuberculin tests has shown that the increase in skin thickness can be correlated with the character of the swelling.

Emphasis is laid on the standardisation of technique, with special reference to accuracy of dosage and skin measurement.

Given a standardised technique it is has been shown that:

(a) The increase in skin thickness bears no relation to the age or the sex of the animal.

(b) In over 90 per cent. of the cattle exhibiting swellings of the accepted negative character the increase in skin thickness does not exceed 2 mm. at the 48th hour, and the total increase does not exceed 3 mm.

(c) In 90 per cent. of the cattle exhibiting swellings of the accepted positive character the increase exceeds 3 mm. at the 48th hour, and the total increase exceeds 5 mm.

(d) An atypical group exists showing total increases between 3 mm. and 5 mm. This group contains animals which may react after an interval of two to three months. Other animals may remain atypical for a longer period and eventually become positive after six to nine months or more. The majority of the atypical group revert to the normal negative range at the next test.

A CASE OF MIDDLE AND INTERNAL EAR DISEASE IN A CAT

By A. J. BAXTER, M.R.C.V.S., D.V.S.M.
Lechlade.

I CAN find very little reference to this trouble in any animal in the textbooks I have available, neither can I remember mention of it in periodicals. That being so, I think this case may be of some interest to others. If anyone can give me a better idea as to how to tackle this problem I should be very pleased to hear from them, although I may never come across another case worth treating.

This case should, I think, be classified as a chronic mastoiditis as it was about two months in duration, but it became acute at the end. The subject was a four-year-old Chinchilla queen.

In the first place the owner telephoned to ask me if he should use an iodine oil preparation I had let him have for a kitten which had had otorrhœa. Treatment with this preparation stopped the discharge relatively soon, but the cat continued to carry its head on one side (the right ear only being affected). About a week before I had the cat in to operate upon, the owner telephoned to say she was getting worse, so I suggested that he should try a sulphonamide preparation, which he did. This apparently had no effect at all as she got worse. He telephoned me the day I fetched her to say that for the last

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day or two she had been having what he called fits, and was not feeding at all well. These fits were evidently attacks of vertigo.

On examination she was found to be carrying her head on one side, tilted about half-way over, and showing some tendency to stagger. There was no sign of pus in the external ear and the pupils of the eyes were normal, as also was the temperature, etc. Some pain was evinced when the mastoid region was pressed, but there was no sign of any swelling. Holding the cat up with the head lower than the body accentuated the symptoms of vertigo. The previous history of the discharge from the ear, coupled with pain in the mastoid region, left no doubt in my mind that there must be pus in the middle ear, which was probably affecting the internal ear by pressure, but not by infection. This was later demonstrated in the operation.

I told the owner that the best thing to do (the cat being a good specimen and a favourite) would be to open up the mastoid cell and see what the condition there was like. I could not give him a definite prognosis for I had not much experience of this type of lesion. Operation had been suggested previously, but the owner could not make up his mind about it. I suppose that the symptoms shown were not acute enough at that time. Consent was given and an operation was performed the same evening after thorough infiltration of the area with local anæsthetic. This worked very well. This method was chosen, in preference to general anæsthesia, owing to the condition of the patient. I think that in most cases it would be better to use a general anæsthetic.

A curved incision was made for about 1¼ in., starting slightly below the middle of the back of the ear and following its contour, keeping about ¼ in. away from the cartilage. The cervical panniculus was next divided, showing the parotid gland, and the incision carried down along its posterior edge. In so doing the posterior auricular vein first, and then the posterior auricular artery, were severed. These had to be ligatured as the oozing would have been too great. The incision was continued through fatty tissue between the submaxillary gland and the sterno-cephalic muscle and then between the masseter and the mastoido-humeralis muscles. The mastoid bulla could be felt through the front edge of the upper belly of the digastric muscle and this was easily separated from the bulla by blunt dissection, after a small cut had been made by the scalpel. Penetration of the thin bone was accomplished with the point of a scalpel. A mucoid type of pus started to ooze out of the slit, showing that there must have been a fair amount of pressure. The resulting small slit was gradually enlarged by the scalpel and artery forceps were used to lift out the pieces of bone. The whole of the lateral face of the bulla and a quantity of ropy pus were removed. There was a certain amount of granulation tissue within the cavity and this was left in place, as it was thought that the best method of healing would be by granulation tissue filling up the cavity. The tympanic cavity was not opened as I understand (since

confirmed) that it connects with the mastoid. This would avoid any further pus formation and hearing was only of secondary consideration.

The wound was left open and was not difficult to keep open afterwards. Drainage was fairly satisfactory. Insertion of a gauze drainage plug was attempted the following day, but it was impossible to keep it in position. Granulation was rapid and the cavity was practically filled by the fourth day.

The patient seemed to be progressing slowly but favourably until midday on the fourth day when slight vertigo appeared, no attack having been seen after the operation. Posture and appetite improved each day. In the afternoon drowsiness came on and it later became apparent that the brain had become involved. She had what appeared to be a slight fit in the evening, became unconscious and died in about half an hour. Rather peculiarly, she purred during most of the unconscious period. I did not expect instant correction of the head position after the operation as the diseased condition had been present for such a length of time.

Post-mortem examination showed that the drainage had been good and that the granulations had nearly filled the cavity. The tympanic cavity was also filled with granulation tissue.

I am now wondering how many cases of middle ear disease occur amongst dogs in particular, because it is quite possible that a number occur and are classed as ordinary "canker." I have in mind those cases in which there is a sudden profuse discharge from one ear which *may* have been due to discharge through a ruptured tympanic membrane. One consolation is that they appear to clear up with treatment, probably indicating that the Eustachian tube again becomes patent, and that the rupture in the tympanic membrane heals up. A point in favour of easy healing must be the simple structure of the mastoid portion of the temporal bone as compared with that of man.

The only other case I have seen in a cat which was proved by post-mortem examination, was in a kitten from the same cattery. This kitten was destroyed as not being worth treating. The owner has since told me that they made a practice of cleaning cats' ears out, and probably this has had something to do with the two cases. Anyhow, I advised him against the practice unless it was really necessary.

Numerous questions arise in one's mind as a result of this case. If operation had been performed much earlier in the course of the disease the chances of recovery must have been much better. The Eustachian tube would probably have functioned again, with a possible avoidance of healing by granulation. If healing had occurred by granulation tissue filling the cavities, would the cure have been satisfactory? Would a better method of operation have been to join the external auditory meatus to the mastoid cavity through the tympanic cavity? This would have been difficult, and one wonders what would have happened afterwards.

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"DROP" (OR PSOAS PARALYSIS?) IN CATTLE

By WILLIAM BARCLAY WATSON, M.R.C.V.S.
Thornbury.

"DROP" is the name given in certain districts to a condition in cattle which I take to be in the nature of paralysis of the psoas muscles.

It affects the pregnant or recently calved animal only; barren cows, maiden heifers, steers and bulls do not appear to be subject.

Symptoms

The cow goes down and is often willing but unable to rise; some may rise with extreme difficulty but be unable to stand for any length of time and while on their legs, seem uncomfortable. The patient usually continues to feed and chew the cud. She lies comfortably while down, and, in fact, seems normal in every other respect unless there are complications such as milk fever, gastric disturbance, etc. She will make frequent attempts to rise, but without success. Often she may be able to raise herself in front but not behind.

On examination, a slight swelling ranging from the size of a small saucer to that of a large plate is often noticed on the back, usually in the region of the turn of the hair; on palpation this swelling is found to be doughy (œdematous) and painful and when pressed hard the cow either attempts to rise or extends her head, flaps her ears, groans and exhibits signs of acute discomfort.

Swelling is not always present, neither is it always in the region mentioned above—it may occur anywhere from between the pin-bones (external angle of ilium) to between the shoulder blades along the spinal column.

When a swelling is not visible, manual examination, i.e., pressure on either side of the spinal column up and down the back, usually "finds the spot" and the cow will exhibit the actions referred to above.

In a few cases neither swelling nor pain is evident in the first instance, but these usually develop within twenty-four hours.

This condition of "Drop" can roughly be divided into three main types:

1. that affecting recently calved cows—say within ninety-six hours of having calved;
2. that affecting cows about to calve—say within one to twenty-one days of the expected termination of pregnancy;
3. that affecting cows in the earlier stages of pregnancy.

Type 1.—In these cases the condition usually accompanies milk fever, but at the time of the first visit this may or may not be evident. If there is milk fever and appropriate treatment is applied, the cow may recover from the milk fever, but still be unable to rise and yet, nevertheless, seem perfectly normal in every other respect, i.e., begins to feed, chew the cud, etc. In those cases in which milk fever is not present at first, the cow is just down and unable to rise. If the patient has calved within twenty-four to thirty-six hours, milk fever often develops subsequently, unless calcium is given in the first instance.

Type 2.—Often in this type of case (i.e., when the cow goes down within say twenty-one days before calving) the patient is unable to rise until she has calved. Not infrequently she will calve "before her time" and will rise shortly afterwards unless complications supervene, such as injuries while attempting to rise, etc. Milk fever sometimes, but by no means always, follows in these cases.

Type 3.—Such cases occur in the earlier stages of pregnancy. They usually respond to routine treatment and the majority are up in two or three days or even within twenty-four hours, though obstinate cases sometimes remain down seven to ten days.

Treatment

Type 1.—In these cases it is always advisable to give a subcutaneous injection of calcium whether milk fever is evident or not (intravenous injection of calcium does not seem to hasten recovery from the "Drop"), followed by a purgative, e.g., ½ to 1 lb. mag. sulph. and stimulant drenches, such as ammon. carb., p. nucis vom., p. gentian, etc.

Embrocation should be rubbed into the back along the spinal column, particularly in the tender region, twice daily.

In obstinate cases a hypodermic injection of grs. ½-1 arecolin may be given with favourable results, sometimes. As a last resource slings may be employed to raise the cow, but this does not always prove to be satisfactory.

It is important that the cow should be turned at least twice daily to prevent tympany, bed sores, etc.

Type 2.—These cases may be treated in the same manner as Type 1 except that the injection of calcium is not necessary. It is not advisable to give arecolin in this type of case for fear of causing abortion.

Type 3.—Such cases are treated as Type 1 except that the injection of calcium is unnecessary.

Complications

These include tympany, impaction, pneumonia, mastitis, bed sores and injuries while attempting to rise, e.g., fractures, luxation of patella, fracture

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of external angle of ilium. Dislocation of the perforatus tendon from the point of the hock is said to be a complication, particularly if milk fever is evidenced.

Discussion

There seems to be no satisfactory explanation as to the origin of this condition, but it seems definitely to be associated with pregnancy and in some cases with calcium deficiency; injury *per se* does not appear to be the cause.

Is it that the œdematous swelling on the back causes pressure on the nerve supply to the psoas muscles (lumbar nerves), thus paralysing them? But what causes the œdematous swelling in the first place—is it toxic in origin?

Wooldridge, in his encyclopedia, refers to a somewhat similar condition known as "adynamic fever or loin drop" in cattle which he attributes to weakness after calving; this condition, however, seems to have little relation to that described above, particularly in the cases which occur shortly before calving or in the early stages of pregnancy.

APPARENT CALCIUM DEFICIENCY IN A SOW

By MAJOR T. G. HEATLEY, O.B.E., M.R.C.V.S.

Woodbridge.

On February 27 a cottager reported he had a sow unable to stand. The cottage was four miles away, and I found a large white sow suckling eight pigs which were seven weeks old. Her breathing was distressed, and she was staggering about, falling and getting up again, and for the safety of the young pigs they were removed from her. The owner reported she had been a bit off colour for two or three days, and did not seem to be giving much milk, as the young pigs seemed more hungry.

The symptoms reminded me of milk fever in cows, so I went back home in order to obtain a supply of calcium, and by the time I returned she was comatose.

I injected subcutaneously 150 c.c. of a 10 per cent. solution of calcium gluconate at three points, behind each ear and the back of the elbow, and left her.

The following morning the owner came in and said the sow the same evening had fed heartily and was apparently all right, but he did not intend putting the young pigs to her again. He wanted to know if he should breed her again and my answer was that I saw no reason for him not to do so.

Abstracts of Current Literature

Experimental Beri-Beri in the Silver Fox. By F. Ender and A. Helgebostad (1939). *Skand. Veter-Tidsk.*, XXIX, 1,232. (Authors' Summary in English.)

First of all, the authors, supported by accounts from veterinary surgeons, describe some spontaneous cases of beri-beri in foxes, mink and ferrets on Norwegian fox farms. The polyneuritic symptoms disappeared after aneurin treatment when this was carried out in time. The symptoms of B_1-avitaminosis in the above-mentioned animals often greatly resembled experimental beri-beri in rats.

Experimental beri-beri in silver fox was obtained by feeding the following B_1-free food:

600 grammes vitamin-free diet, consisting of:

21% casein,
63% corn-starch,
10.5% hardened vegetable-fat, and
5.3% salt mixture.

52 grammes autoclaved brewer's yeast,
300 „ dried whale meat (B_1-free), and
12 „ $CaCO_3$.

Each animal was also given daily two grammes medicinal cod liver oil and half a tablet "Cantan" (vitamin C). In order to make the starch more easily digestible, the starchy part of the food was boiled.

Already after 6-8 days symptoms were observed of B_1-avitaminosis attended by diminished appetite, weakness and depression.

To prevent inanition, the animals were compulsory fed. Evident symptoms of beri-beri were observed after 18-21 days, attended by disturbances of the motility, restraint and rolling movements (rotation round the longitudinal axis of the body), all resembling the symptoms which occur in experimental beri-beri in rats.

The convulsions consisted of rhythmic masticatory cramps, accompanied by ptyalism. Then followed attacks of general convulsions with *opisthotonus* and spasms of the legs. The duration of the attacks was between a few seconds and some minutes. Clonic spasms of the extremities were often seen.

After treatment with the aneuritic vitamin the symptoms rapidly disappeared.

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Trichomoniasis in Turkeys. By L. D. Bushnell and M. J. Twiehaus (1940). *Vet. Med.*, XXXV, 103.

TRICHOMONAS infection in the pigeon has been known for a long time but it was not till 1933 that Jungherr recognised such an infection in turkeys. (He described infection in young chicks in 1927.)

It would appear from the literature cited that two distinct forms of the parasite are involved in the disease in turkeys and on this point the authors state that: ". . . on the basis of age susceptibility and the location of the parasite there are indications that there are at least two forms."

It has not been shown whether the forms found in the turkey are the same as those in pigeons.

The symptoms in young poults include great depression and drowsiness, the affected birds sitting or standing with their eyes closed and their beaks resting on the ground. There is also sagging of the wings, loss of appetite and emaciation. Affected young birds may die in 24 hours. In older birds the crop is usually depressed or sunken and may be pendulous. It is stated that from the mouth is emitted a characteristic, though not diagnostic, putrid odour. Repeated attempts at deglutition may be seen before death. Affected adult birds may live for several days or even weeks.

The lesions seen at post-mortem examination include white or yellowish nodules on the mucosa of the mouth, œsophagus and crop, varying in size from 0.5 to several millimetres in diameter. The mucous glands are infected and may contain a semi-caseous material and may be surrounded by a ring of exudate. In the centre of the area there is often an elevated portion. Lesions may coalesce to form a mass of necrotic ulcers in the wall of the crop. Sometimes the submucosa is involved and actual penetration may occur. The mucosa in the proventriculus may be necrotic and may slough. It is usually covered by a thick, diffuse layer of semi-gelatinous mucus. The gizzard is not involved. The lesions in the intestines are catarrhal in character, the cæca being frequently involved, and in such affected areas the parasites are easily found on microscopic examination.

Control of the infection has followed the adoption of hygienic measures and the use of copper sulphate in the drinking water (one teaspoonful in five gallons of water is recommended, i.e., a solution of about 1 in 2,000). It was found that the birds soon learn to drink it and that it can be used for drinking purposes for several weeks without causing injury. The removal of all wet and decomposing straw was found to be important.

Tuberculin Reactions in Cattle affected with Bang's Disease. E. G. Hastings, Janet R. McCarter, B. A. Beach, W. Wisnicky and J. S. Healy (1940). *J.A.V.M.A.*, XCVI, 186.

THE authors point out that Holth in Norway reported that cattle affected with Bang's disease but free from tuberculosis react to tuberculin, injected

intradermally or subcutaneously. The authors injected in all, 135 cows experimentally with Br. abortus, examined their sera for agglutinins and tested them with tuberculin, intradermally. They carried out similar tests on a number of cows naturally infected with Bang's disease. The data presented show that definite Br. abortus infection was present, but in no case was a positive tuberculin reaction found. The results thus differ from those obtained by Holth. The authors state that possible reasons include that Holth's tuberculin may have been more potent than that used by them or that the cattle which Holth examined were sensitised to some agent other than Br. abortus, e.g., avian tubercle bacilli or some saprophytic acid-fast organisms. Although the authors agree that there is some immunological relationship between Br. abortus and the tubercle bacilli, they state that the indications are that no significant number, if any, of the no-visible-lesion cattle in Wisconsin have reacted because of infection with Br. abortus.

Changes in the Virulence of Distemper Virus on Fur Animal Ranches. By R. G. Green (1939). *Skand. Veter-Tidsk.*, XXIX, 1,227.

The newly discovered character of the distemper virus, modification by animal passage, is basic to all consideration of distemper in fur-bearing animals. Not only does this modification allow the development of a practical vaccine for foxes and minks, but it also allows an understanding of the disease as it is seen naturally. Many natural epizootics of distemper in fur-bearing animals have been difficult to understand. Sometimes an epizootic decimates the herd of foxes on a ranch but causes little or no mortality among the minks. Less occasionally distemper produces a severe epizootic in minks without spreading to foxes on the same ranch. Even in a single species, such as the fox, distemper manifests itself differently at various times. Early in epizootics, especially, foxes are apt to die very suddenly in full flesh, with no discharge from the eyes or nose. An explanation of these variations is to be found in the natural modification of the distemper virus analogous to the modification that we have accomplished and demonstrated experimentally.

Normal type of distemper virus.—The usual type of distemper virus in nature has the ability to produce infections in such diverse species as foxes and minks. Strains of this type isolated from foxes and dogs produce typical distemper when injected into ferrets or minks. A distemper virus capable of spreading from one species to another, producing severe infections, may be termed a normal distemper virus. This type is to be considered the original type of virus developed among animals free in the wild where the disease spreads readily from one species to another.

Natural strains of partially modified virus.—The congregating of many animals of the same species, as has been accomplished by man, leads to definite changes in the distemper virus. Whereas in the wild distemper might easily spread from a weasel to a fox, from the fox to a raccoon, and on to other

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species, distemper producing an epizootic on a fox farm spreads only from fox to fox. We have shown experimentally that as few as five passages through a single species of susceptible animal produces a discernible change in the pathogenic properties of distemper virus.

Distemper modified in foxes.—Distemper that has spread through a fox farm over a period of years has become greatly modified. It has been most puzzling to see distemper cause a high mortality among foxes on a ranch and not spread at all to minks. The explanation is now very plain. In cases of this kind the particular strain of virus that spread to the ranch was already highly adapted for foxes and had probably come from a long series of infections that passed through dogs and foxes only, probably through foxes chiefly. The virus had thus become so modified that it was incapable of producing a severe infection in minks. As it was carried to a ranch on which both foxes and minks were raised, it spread rapidly through the foxes as a virulent infection, and very slowly, if at all, through the minks as a mild infection.

Distemper modified in minks.—The opposite situation, in which disease appears among minks and does not spread to foxes, has a similar explanation. The distemper virus is a strain that has previously passed through minks, ferrets, weasels, or similar animals, and become so modified that it produces only a mild infection, or no infection, in foxes although it produces a virulent infection in the minks.

Variation in symptoms.—It seems now that we also have an explanation for the peculiar manifestations of distemper that sometimes appear early in an epizootic. During my years of experience I have seen epizootics of distemper in which the first cases did not appear to be distemper at all. The foxes died while in full flesh. They did not show any secretion in the eyes and nose. At necropsy no pneumonia was found, and the general pathology did not indicate distemper. The inclusion bodies of distemper, however, were present in these early cases. During subsequent weeks, as foxes continued to die, the character of the disease changed. Death did not occur suddenly. The animals became emaciated, and a marked secretion was present in the eyes and nose. The disease was now typical distemper. In our experimental work on distemper we have duplicated the changes just described. When a virus that has been partially modified in ferrets or minks is injected into foxes, it produces a low mortality, but once symptoms appear, many of the animals that succumb die quickly in full flesh. If the virus is passed through a series of foxes it becomes more adapted to the fox, the visible symptoms appear earlier in the course of the disease, and the apparent duration of symptoms is much prolonged. The animals become thin and show marked secretion from the eyes and nose.

Effect of secondary invasion.—It is recognised that distemper in dogs owes much of its typical character to the activity of secondary invading bac-

teria. In dogs the distemper virus produces a relatively mild infection that opens a path for secondary bacterial infection. Although secondary invaders are of importance in fox and mink distemper, their role is not the same as that in dogs. In both foxes and minks the distemper virus produces a severe infection and the animals die primarily from the virus and not from secondary infections.

This newer knowledge of distemper allows a much clearer understanding of the disease in all species of susceptible fur animals. It makes possible the production of non-virulent viruses that may be used as a vaccine to give quick and lasting immunisation. (Reproduced from *Skand. Veter.-Tidsk.* [1939] XXIX.)

The Anthelmintic Efficiency of Phenothiazine. H. McL. Gordon (1939). *Aust. Vet. Jl.*, XV, 245.

In this article are recorded some observations on the results of the use of phenothiazine in worm-infested sheep. Against Hæmonchus contortus, treatment of 18 sheep with the pure drug in capsules was 100 per cent. effective. Post-mortem examinations were carried out. Doses of 0.3 to 0.75 grams per kilogram body weight, repeated on three successive days, was also 100 per cent. effective in seven sheep. It is pointed out that phenothiazine and carbon tetrachloride are the only drugs which show a high degree of efficiency against H. contortus when swallowed into the rumen. Some evidence was obtained that, following administration of the drug, the number of Trichostrongylus spp. was reduced but exact determinations were not made. It would appear that sufficient concentration of phenothiazine is maintained in the fæces to destroy the developing pre-infective larvæ. The destructive action of the drug on both larvæ and adult worms suggests its possible use in lick form. The drug also proved to be an efficient anthelmintic for the treatment of œsophagostomiasis in sheep, removing from 60 to 100 per cent. of the worms in nearly 78 per cent. of the sheep treated. The dose can be reduced provided a dose of copper sulphate is used to bring out reflex closure of the œsophageal groove so that the drug can be swallowed into the abomasum.

The author's conclusions are: It is evident that a great deal of further work is required, but there are clear indications that

(1) Phenothiazine offers great promise for the successful treatment of œsophagostomiasis by drenching.

(2) That by using a larger dose rate satisfactory results may be obtained without the necessity for ensuring that the drug passes direct to the abomasum.

(3) Phenothiazine is a very efficient anthelmintic against Hæmonchus contortus.

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"Swayback" Studies in North Derbyshire. I. The feeding of Copper to Pregnant Ewes in the Control of "Swayback." By G. Dunlop, J. R. M. Innes, G. D. Shearer and H. E. Wells (1939). *J. Comp. Path. & Therap.*, LII, 259.

THIS paper is an account of a field experiment carried out in North Derbyshire in which 260 ewes were involved. "Swayback" is the name applied to a disease of lambs characterised by a demyelination. It had already been shown by various workers that copper administered in the pregnant ewes in "swayback" areas had the effect of preventing the occurrence of the disease in their lambs. In the present experiment the ewes were divided into four groups, two of which acted as controls, receiving no copper treatment; the third group had access to salt licks containing 0.3 per cent. copper in the form of copper sulphate; the licks for the fourth group contained 1.0 per cent. copper. The groups were divided into lots so that the time during which the sheep had access to the licks varied from practically the whole period of gestation to a few weeks prior to lambing. Careful post-mortem examinations were made on all dead or diseased lambs. From the results it is concluded that the administration of copper contained in salt licks to pregnant ewes prevented swayback in their lambs. Satisfactory results were obtained when the licks containing 0.3 per cent. copper were available to the ewes during the greater part of their pregnancy period as well as when the amount was increased to 1 per cent., and made available for only four weeks before lambing. This latter result supports the conclusion derived from pathological data that the demyelination process in swayback does not begin in the fœtal lamb until a relatively late stage of intra-uterine life. The disease in the lamb is not one of copper deficiency *per se* in the pregnant ewe. The exact role of copper in the causation or prevention of the disease is not yet understood.

Duration of Immunity Induced in Calves by B.C.G. II. Resistance Induced by Multiple Doses of the Vaccine. By J. B. Buxton, R. E. Glover, T. Dalling and T. J. Bosworth (1939). *J. Comp. Path. & Therap.*, LII, 273.

THIS article deals mainly with the results of the use of multiple doses of B.C.G. vaccine over a period of three years in cattle kept at the laboratory and subjected to infection with virulent organisms, some at the termination of the experimental period of three years, some a year and a half after commencement of the treatment and others shortly after the first dose of vaccine, the infection being repeated at intervals. In all cases the vaccine was injected every six months, intravenously.

The conclusions from the experiment are as follows. Cattle tolerate well doses of 50 to 100 mgm. B.C.G. vaccine injected intravenously at six-monthly intervals. In one experiment eight calves were vaccinated at six-monthly intervals and kept in isolation during the period, and then virulent tubercle bacilli

were given by mouth. Control, unprotected cattle fed with the same dose of the virulent bacilli became typically infected with tuberculosis, the extent varying in individual animals, but of the B.C.G. treated cattle, five resisted the infection completely and in the other three the degree of infection appeared to be slight.

Cattle treated every six months with B.C.G. and exposed to continual infection soon after the first dose of vaccine or after 18 months following the first dose of vaccine did not withstand infection to such an extent. Thus, in 28 animals, 10 were completely free from infection, 14 showed slight or moderate lesions, while 4 were severely affected.

Sensitivity to tuberculin was studied and it appeared that each reinforcing dose of vaccine tended to augment the skin sensitivity, but the stimulus seemed to be less apparent with successive doses of vaccine.

It is also pointed out that from some lymphatic glands in which there was no microscopic evidence of infection, virulent organisms were demonstrated by guinea-pig inoculation.

The Value of Phenothiazine in the Treatment of Œsophagostomiasis in Sheep. By F. H. S. Roberts (1939). *Aust. Vet. Jl.*, XV, 237.

Following on the observations of workers in America on the value of phenothiazine in the control of certain intestinal parasites, the author tested its value against O. columbianum in sheep. A preliminary test, 4 gms. in 4 per cent. copper sulphate, was carried out on five sheep and four of them passed worms. Further experiments were then carried out in which (1) small doses of the drug were administered following copper sulphate, and (2) large doses were given without copper sulphate. The general results indicate that the drug, in a dose of 0.15 grams per lb. body weight, following copper sulphate stimulation and after starvation for 24 hours, gave satisfactory results. It is pointed out that better results could probably be obtained by increasing the dose to 0.2 grams per lb. body weight or by increasing the starvation period. When 0.4 grams per lb. body weight were used without copper sulphate stimulation, the results were very efficient in adult sheep but less satisfactory in lambs. It is stated that the factors which render an animal resistant to treatment are those responsible for delaying the passage of the drug to the large intestine, thus permitting a high percentage of it to be broken down and absorbed. The following factors have been implicated up to date: tendency to constipation, resulting in a decreased rate of peristalsis and an increase in the amount of ingesta in the colon; some factor present in unstarved animals, probably associated with quantity of ingesta; the condition of the sheep—sheep in poor condition appear to respond better than those in good condition.

Lambs heavily infested with Hæmonchus contortus were also treated with the drug and it was found that as low a dose as 0.045 grams per lb. body weight, following the administration of 2 c.c. of 10 per cent. copper sulphate

was followed by the passing of large numbers of the worms. Very few worms were detected on post-mortem examination. It is further stated that a dose of 0.15 grams per lb. body weight, following copper sulphate, appears to be almost 100 per cent. effective against this species of worm.

The drug appeared to be entirely ineffective against Trichuris.

(The drug used was the product marketed by Imperial Chemical Industries as "Thiox," containing 93 per cent. phenothiazine, 5 per cent. beta naphthol and 2 per cent. of a further compound included as a wetting agent.)

Paratyphoid Infections in Birds. By E. Jungherr (1940). *Vet. Med.*, XXXV, 112.

In the author's view the interest in paratyphoid infections in birds is because: (1) many sero-types of Salmonella identical with those in mammalian hosts occur in birds; (2) a variety of avian species are subject to paratyphoid infections; (3) birds may constitute an important natural reservoir of paratyphoid organisms; (4) paratyphoid infections may occur in pullorum-clean stock and may thus upset control work; (5) paratyphoid infections of birds are of potential importance to public health.

An outline is given of the main characters of the Salmonella group, 70 different sero-types having been recognised up to date. Paratyphoid infection in birds is said to be world-wide and occurs in birds such as chickens, turkeys, geese, ducks, pigeons, etc., wild birds like finches, and in some birds in zoological gardens.

The commonest infections are those due to S. typhi-murium (formerly known as S. ærtrycke) and S. enteritidis (Breslau), while the "Anatum" type, originally isolated from ducks, has recently been found in chickens and turkeys. Other types have been more rarely found. Young birds are more commonly affected.

Symptoms of infection are not characteristic: some diarrhœa may be present as well as a general unthriftiness and variable losses. In affected young pigeons there may be lameness and swollen joints.

Lesions are not characteristic—there is usually congestion of the liver and spleen and in the liver may occur focal necrosis and distension of the gall bladder. Young pigeons may show a purulent arthritis. In older birds the ovary and testicles seem to be predilective sites and transmission of infection through the egg is recognised in some cases. The organisms are eliminated through the excreta. Diagnosis can only be made by laboratory examinations.

Attention is drawn to the occurrence of human cases of food poisoning traced to infected eggs of ducks, geese and pigeons and to infected goose liver and meat. It is also pointed out that egg shells may become contaminated by fæces and may thus constitute a danger in handling food products.

Control of such bird infections is viewed from two standpoints—man and animals. It is stated that in Western Europe it has been the practice for several years to label duck and goose eggs and to request their thorough cooking. Proper refrigeration at the time of preparation, followed by heat sterilisation, are said to be of considerable use in controlling paratyphoid food poisoning from meat products. General sanitary principles must also be relied on to prevent transmission.

Control of infections in birds is practised by vaccination and eradication. Formalinised autogenous vaccines are said to have given good results in the control of paratyphoid of pigeons in Roumania.

The value of serological tests is discussed. Cultural examination of fæces has also been used for detecting carriers, but the results are not too encouraging. Chemotherapy (e.g., sulphanilamide) has not been successful. The practice of good hygienic measures is important.

News

FINNISH WAR HORSES

THE Royal Society for the Prevention of Cruelty to Animals has drawn our attention to the conditions in Finland concerning wounded and sick horses. At the present time there are some 12,000 such animals to be treated. The R.S.P.C.A. has purchased and despatched quantities of materials for use on these animals to the value of some thousands of pounds. More materials are still urgently required and the R.S.P.C.A. is appealing for funds with which to purchase them.

The Association has prepared an interesting and instructive leaflet which can be had from the Secretary, R.S.P.C.A., 105, Jermyn Street, London, S.W.1.

OBITUARY

PATRICK PLAYFAIR LAIDLAW, K.T., M.B. (Camb.), F.R.C.P., F.R.S.

MEDICAL and veterinary science have sustained a severe loss in the death, on March 19, of Sir Patrick Laidlaw. His passing has left many of us without that guiding hand on which we had come to rely so much. To the veterinary profession, generally, his name will best be remembered by his association with

Dunkin when they carried out the painstaking, steady researches which led ultimately to the evolving of the prophylactic and therapeutic treatment of distemper in the dog. Laidlaw's name, however, will live in the world of science in association with many other investigations. His contributions to the study of viruses generally is summed up by Sir Henry Dale, writing in *The Lancet* (30/3/40), in the following terms: "Laidlaw's pioneer work on virus infection will probably rank as his most important contribution to the advancement of knowledge."

Of a retiring disposition, he steadily carried out his research work and led teams of workers, and by his ever-ready encouragement and help came to be regarded in the scientific world, generally, as a man whose opinion was to be valued. Whether in the laboratory or out of it, at committee meetings, etc., Laidlaw's sound opinions were always acted upon and to many of us his kindly help meant much.

His delivery of the Rede Lecture in Cambridge in 1938 will stand out always in the memories of all of us who listened to him. His published lecture marks a milestone in the knowledge concerning viruses and will remain as a memorial to a great man.

SOLUSEPTASINE PRICE REDUCTION

SOLUSEPTASINE, the only colourless British sulphonamide in concentrated aqueous solution, has been reduced in price, state the manufacturers of this product, Pharmaceutical Specialities (May & Baker), Ltd., Dagenham. 30 c.c. bottles of 20% solution, packed especially for veterinary use, are now listed at 7s. 6d. instead of 9s.

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